



Indoor Air Quality Testing & Pediatric Asthma Surveillance in Massachusetts Public Schools

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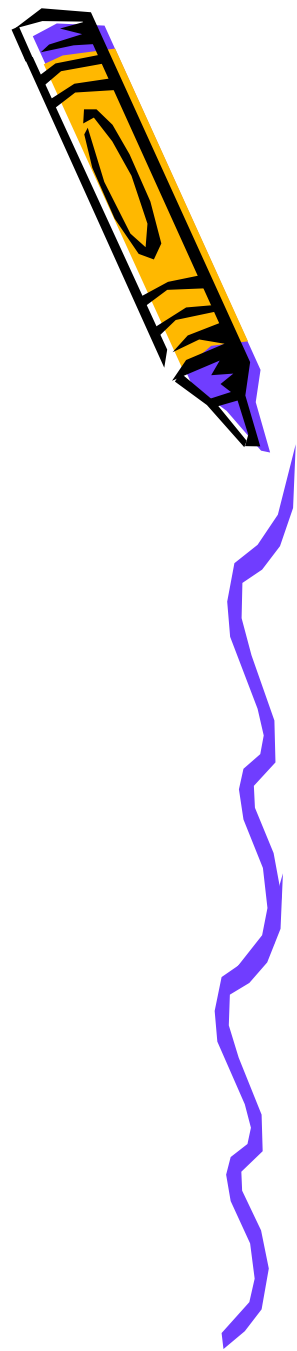
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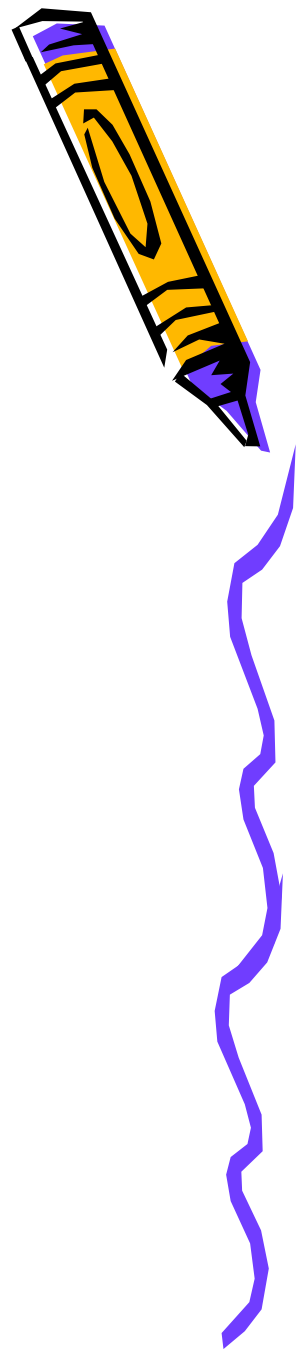
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Presentation Outline

- I. Introduction
- II. National Asthma Statistics
- III. Massachusetts Statistics &
Regulatory Authority
- IV. Linkage Variables
- V. Linkage Results
- VI. Summary of EPHT Experience



I. Introduction

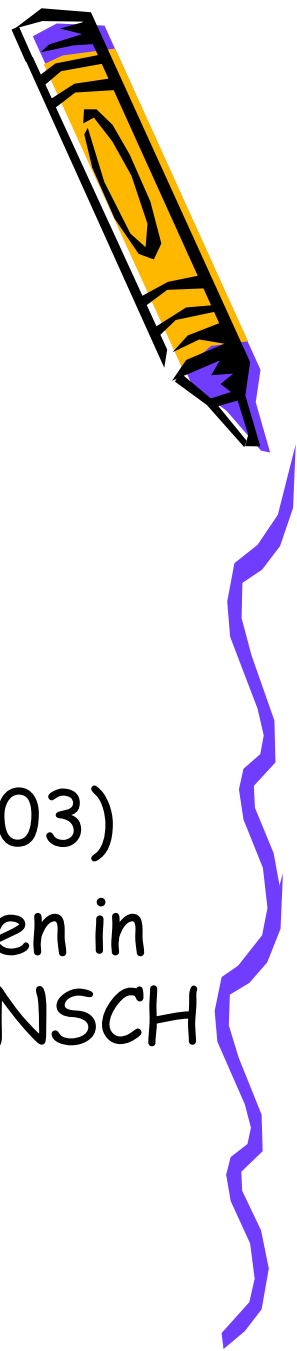
To link indoor air quality (IAQ) data
with asthma surveillance data in
select Massachusetts schools



II. National Asthma Statistics

- Prevalence among children 1-4 yrs old has increased 160% since 1980.
- For children 0-14 yrs asthma prevalence is 7.9% (NHIS 2004).
- Number of children diagnosed has more than doubled since 1983 to over 6.3 million (CDC).
- Massachusetts ranks 3rd for lifetime prevalence of asthma nationally behind Puerto Rico & Oregon (NBRFSS 2003).
- Causes include both ambient air pollution (PM 2.5 & ozone) and indoor air pollution (mold & mildew, dust, pets & pests, smoking).





III. MA Asthma Statistics

- 10.0% of children in grades K-8 in Massachusetts have lifetime asthma (MA/EPHT/2005)
- 9.2 % of children in Massachusetts have current asthma (3rd highest, BRFSS 2003)
- Estimates of 137,000 to 152,000 children in Massachusetts are living with asthma (NSCH 2003)





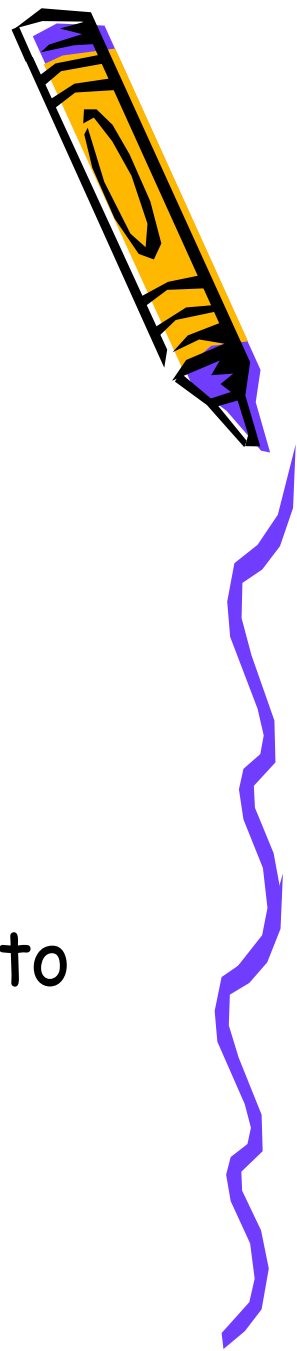
MA Asthma Statistics (cont.)

- IAQ in Schools (MDPH 1999 study)
- MVPAS
- Authority for school based surveillance



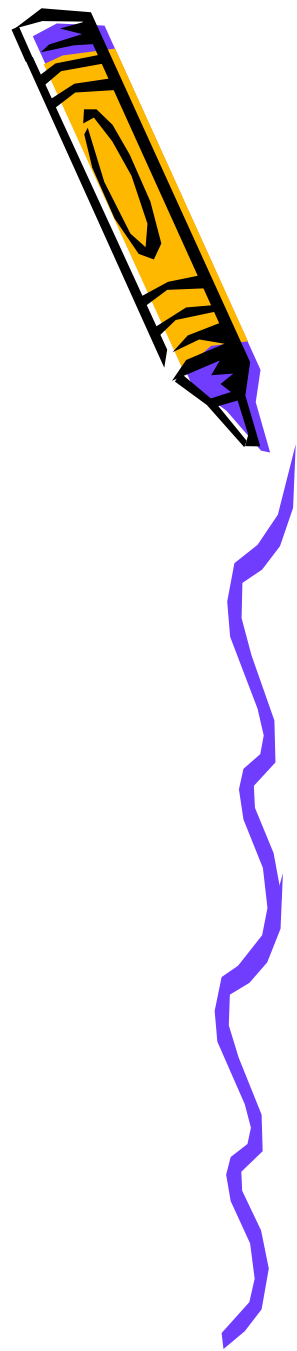
Regulatory Language Allowing Use of School Health Records

- DPH Access to Records (statute)
C. 111, s.24A (1960)
- MA Student Record Regulation
603 CMR, 23.7 (4)(h)(1976)
- Medication Administration
105 CMR 210.000 (1993)
- Surveillance of Diseases Possibly Linked to
Environmental Exposures
105 CMR 300.192 (2004)



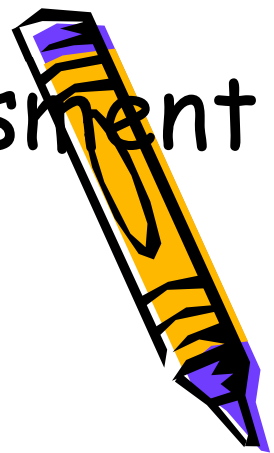
IV. Linkage Variables

- Environmental
- Health/Demographics



Indoor Air Quality (IAQ) Assessment Schools Assessed

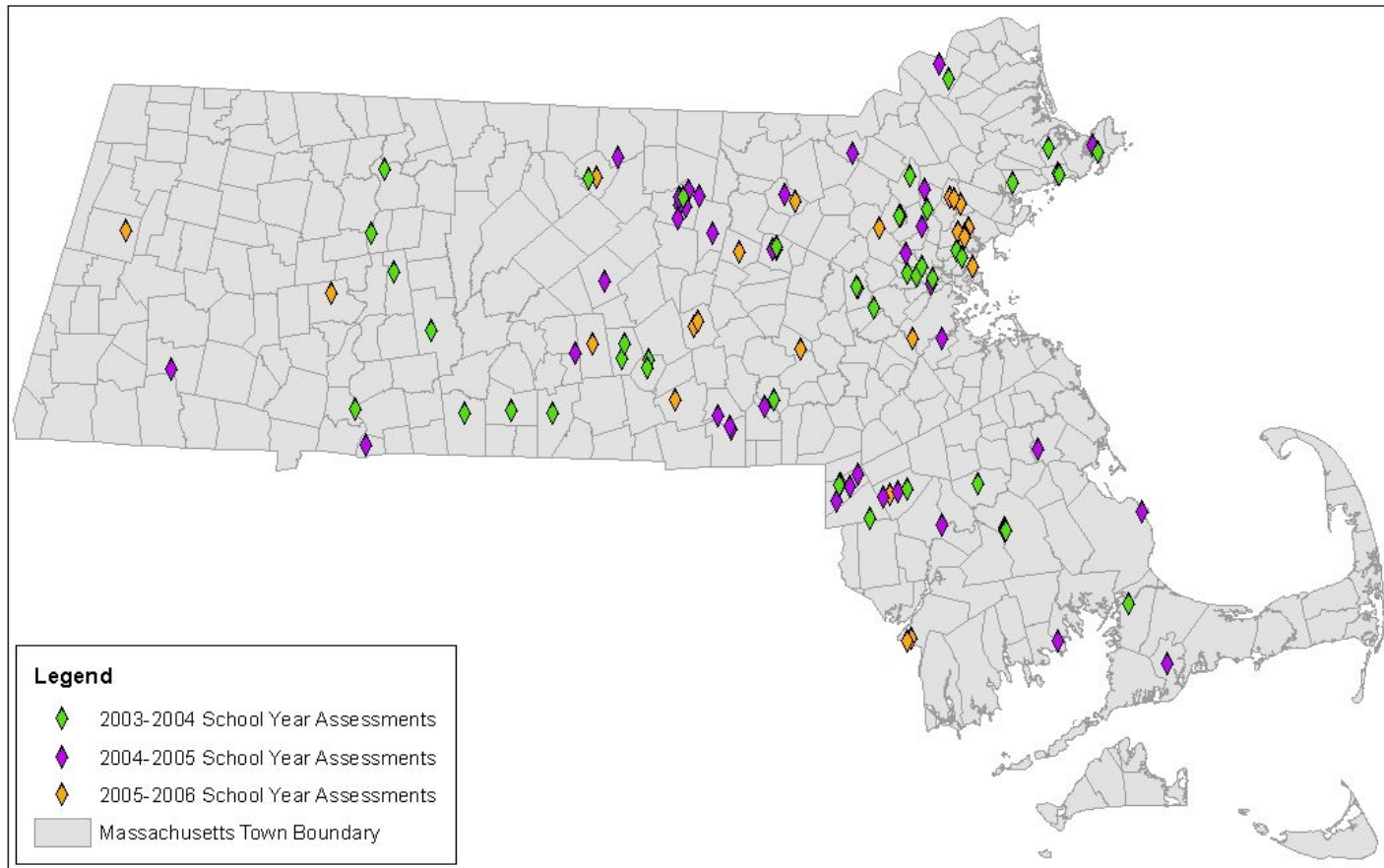
- 2003 through 2006
 - Indoor air quality (IAQ) assessments completed a total of **106 schools**
 - During 2003-2004: 40 school assessments completed
 - During 2004-2005: 40 school assessments completed
 - During 2005-2006: 26 school assessments completed
- 1999 through 2003
 - IAQ data available for additional **162 schools** from school years 1999/2000 through 2002/2003



IAQ Assessments

Schools Assessed 2003-2006

MDPH Indoor Air Quality School Assessment Locations
November 2003 - June 2006



Center for
CEH
Environmental Health



Geographic data supplied by: Massachusetts Executive Office of
Environmental Affairs, MassGIS.

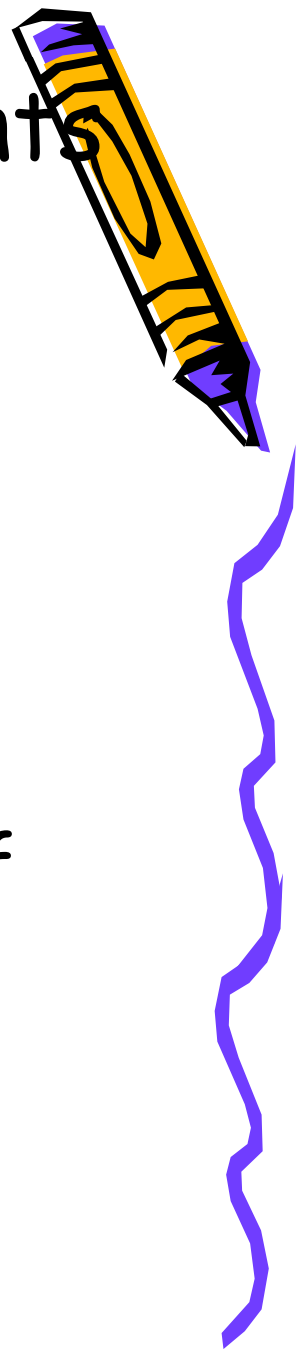
0 15 30 60 Miles

Coordinate system: Massachusetts State Plane Mainland Meters (NAD83)



Massachusetts IAQ Assessments

Evaluate:



- **Quantitative variables** measured include temperature, relative humidity, CO₂, CO, & PM 2.5.
- **Qualitative variables** include presence of water damaged materials, sources of VOCs, etc.



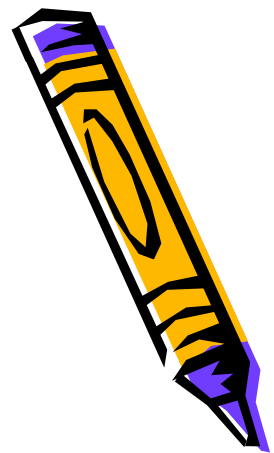
IAQ Assessment

Point Source Irritants

Point source pollution parameters:

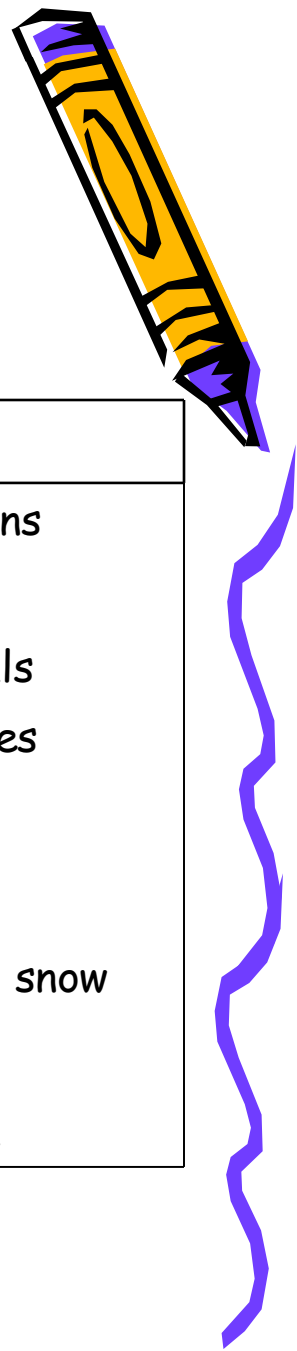
- Carbon monoxide
pollutant levels of fresh air introduced to a building should not exceed the NAAQS* level of **9 ppm in an eight-hour average**.
- Airborne Particles
particulate levels for particulate matter with a diameter of 2.5 micrometers (μm) (PM_{2.5}) should be maintained below the NAAQS* level of **65 $\mu\text{g}/\text{m}^3$ over a 24-hour average**
- Total volatile organic compounds (TVOCs)

*The NAAQS were adopted by reference in the BOCA National Mechanical Code of 1993, which is now an HVAC standard included in the Massachusetts State Building Code.



IAQ Assessment

Point Source Irritants



Potential Sources of Indoor Air Pollutants

air fresheners	art rooms	building renovations
carpeting	chalkboards	chemical storage
cleaning products	custodial products	dry erase materials
fuel oil vapors	janitorial supplies	lamination machines
mimeograph machines	nail application solvents	new furniture
pesticide applications	photocopier	pottery kilns
school/clerical supplies	sewer gas from dry traps	spray on artificial snow
spray paint	tennis balls	vehicle exhaust
vocational shops	water heaters	wood stove smoke

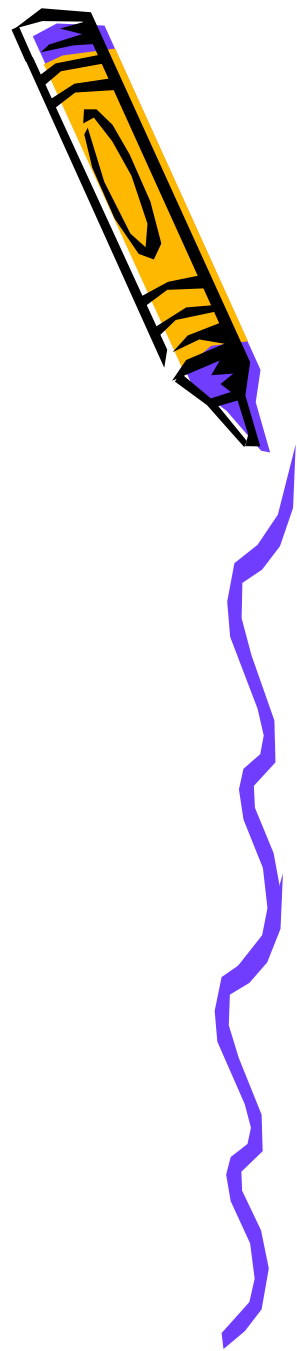


IAQ Assessment

Ventilation

Parameters typically measured to ascertain ventilation equipment function:

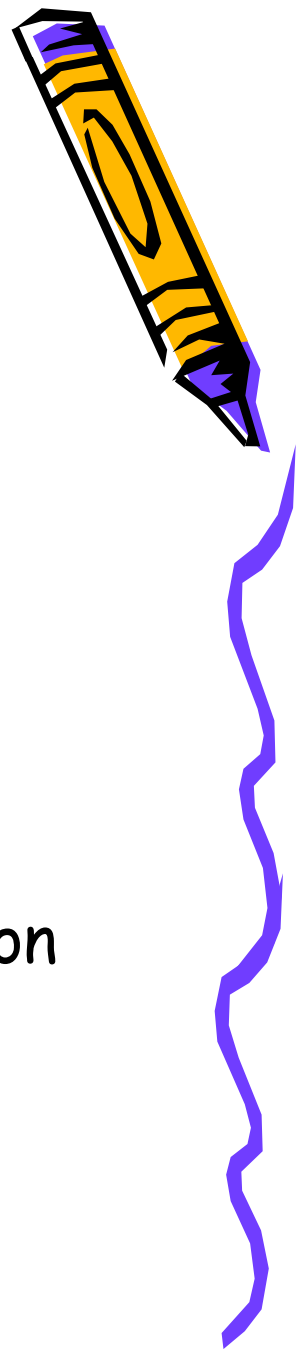
- Carbon Dioxide Levels:
 - ≥ 800 ppm indicates inadequate ventilation
 - 600-800 ppm acceptable air exchange
 - < 600 ppm is preferable in elementary schools
- Temperature: Comfort Range: 70 ° F to 78 ° F
- Relative Humidity: Comfort Range: 40% to 60%



IAQ Assessment

Microbial Growth

Supporting Media*



- carpets
- ceiling tiles
- drapery
- sheet rock
- paper
- books
- particle board/plywood
- hard wood
- cardboard
- plants/potting soil
- fiberglass insulation
- soft plastic



IAQ Variables Linkage Definition



Carbon Dioxide:

- For school locations identified as classroom, cafeteria & library.
- Examining carbon dioxide levels based on the following:
 - **Mean** CO₂ level for schools in rooms with open windows
 - **Mean** CO₂ level for schools in rooms with closed windows
 - **Mean** CO₂ level for schools in rooms with open and closed windows
 - **Percentage** of school classrooms with mean CO₂ levels greater than 800 ppm



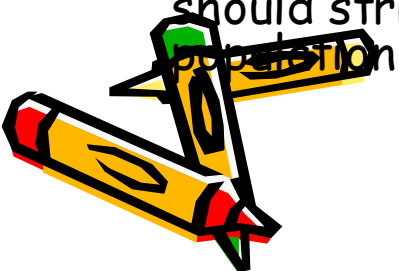
IAQ Variables

Linkage Definition



Carbon Dioxide

- Mean CO₂ concentration ranges:
 - 2003/2004: 582 ppm to 1314 ppm
 - 2004/2005: 501 ppm to 1392 ppm
 - 2005/2006: 550 ppm to 1410 ppm
- Number of schools with more than half of areas averaging CO₂ levels greater than 800 ppm:
 - 2003/2004: 13 of 40 schools
 - 2004/2005: 13 of 40 schools
 - 2005/2006: 13 of 26 schools
- MDPH-CEH recommends that CO₂ levels not exceed 800 ppm but schools should strive to reach 600 ppm due to children being a susceptible population



IAQ Tracking Variables Definition



Particulate matter:

- For school locations identified as classroom, activity/shop, art, library
- Examining PM_{2.5} levels based on the following:
 - **Mean** PM_{2.5} level
 - **Percentage** of school classrooms with mean PM_{2.5} levels greater than 65 ug/m³



IAQ Variables Linkage Definition

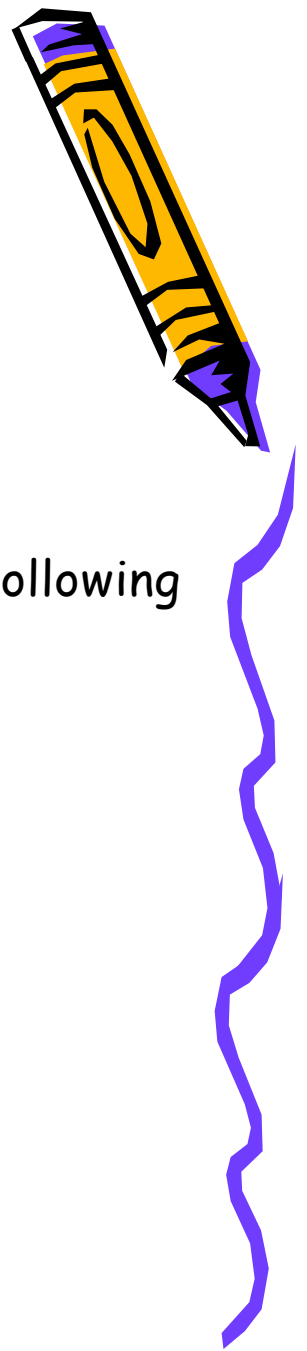


Particulate Matter 2.5

- Mean PM2.5 concentration ranges:
 - 2003/2004: 3 $\mu\text{g}/\text{m}^3$ to 73 $\mu\text{g}/\text{m}^3$
 - 2004/2005: 5 $\mu\text{g}/\text{m}^3$ to 80 $\mu\text{g}/\text{m}^3$
 - 2005/2006: 4 $\mu\text{g}/\text{m}^3$ to 34 $\mu\text{g}/\text{m}^3$
- Number of schools with mean PM2.5 levels greater than 65 $\mu\text{g}/\text{m}^3$
 - 2003/2004: 2 of 40 schools
 - 2004/2005: 2 of 40 schools
 - 2005/2006: 0 of 26 schools
- Current US EPA standards for PM 2.5 in ambient air is 65 $\mu\text{g}/\text{m}^3$



IAQ Variables Linkage Definition

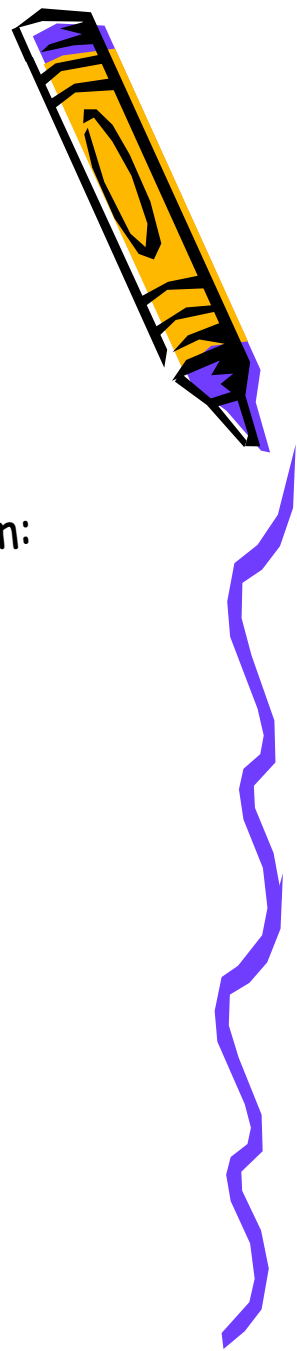


Moisture:

- For school locations identified as classroom or library
- Examining moisture based observation of at least one of the following conditions in an aforementioned area:
 - Water-damaged ceiling
 - Water-damaged carpet
 - Water-damaged ceiling tiles
 - Visible mold growth on ceiling
 - Visible mold growth on carpet
 - Visible mold growth on ceiling tiles



IAQ Variables Linkage Definition

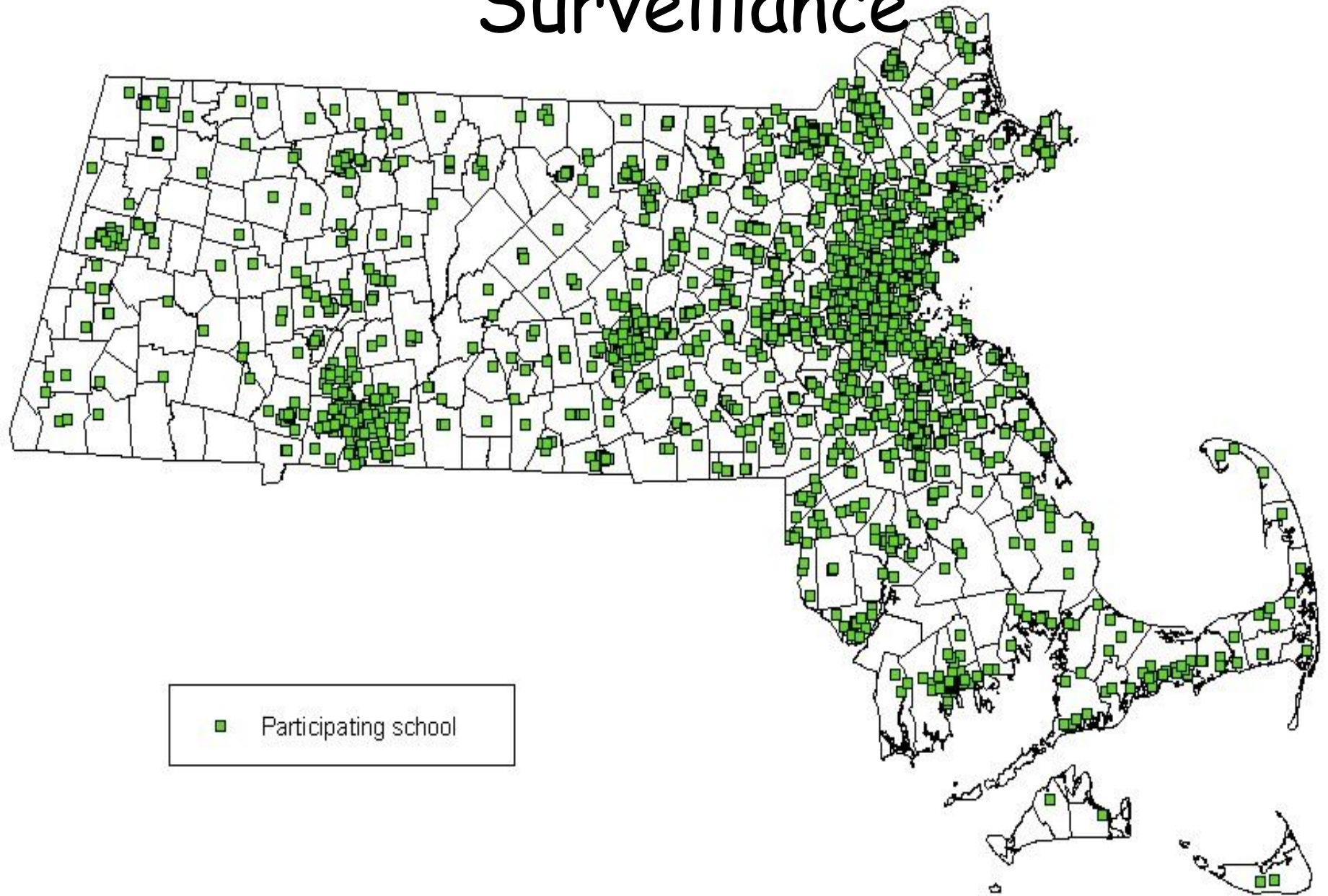


Moisture

- Range of percentage of school areas evidencing moisture problem:
 - SY2003-2004: 2% to 47%
 - SY2004-2005: 2% to 27%
 - SY2005-2006: 2% to 40%
- Number of schools evidencing moisture classrooms:
 - SY2003-2004: 24 of 40 schools
 - SY2004-2005: 33 of 40 schools
 - SY2005-2006: 16 of 26 schools



Schools Participating in Asthma Surveillance



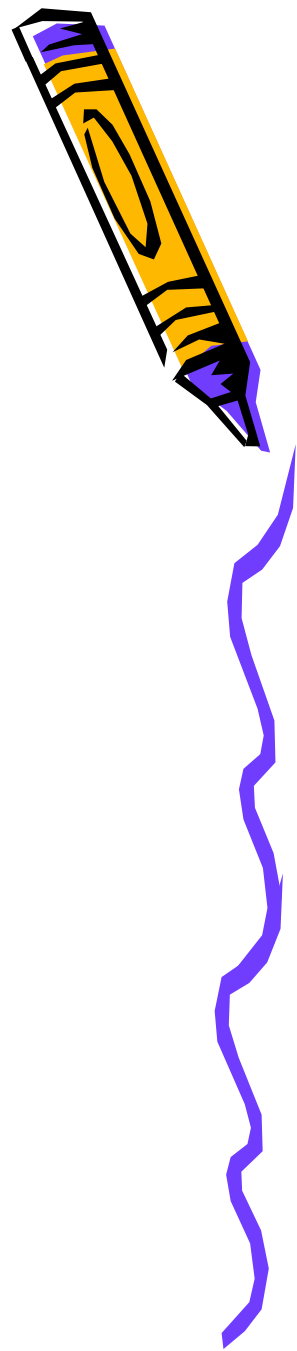
School Participation

Year 1 958 public schools invited
668 participated (70%)

Year 2 2,128 public/private schools invited
1,664 participated (78%)

Year 3 2,128 public/private schools invited
1,808 participated (83%)

Year 4 2,201 Public/private schools invited
1,880 participate (85%)



Pediatric Asthma Prevalence Massachusetts

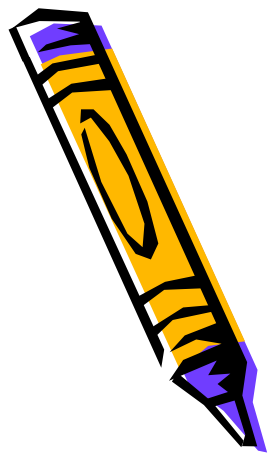


- Year 1 (2002-2003 school year) - 9.2%
- Year 2 (2003-2004 school year) - 9.5%
- Year 3 (2004-2005 school year) - 10.0%
- Year 4 (2005-2006 school year) - 9.8%

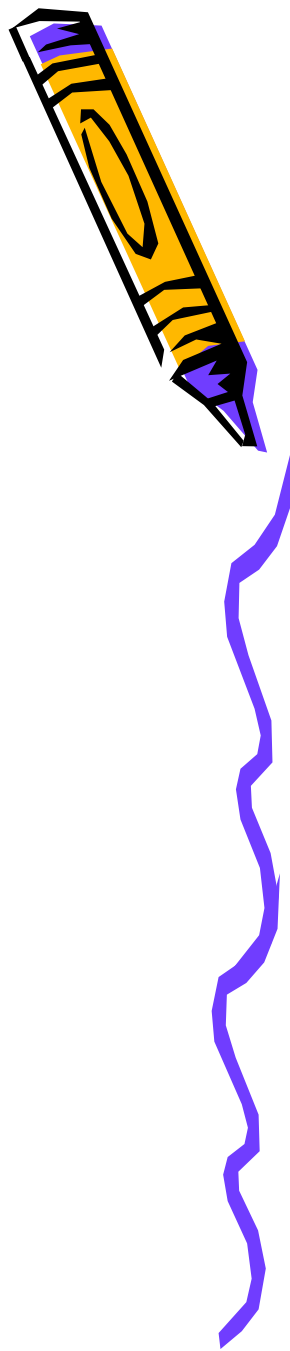


Linkage Analysis

Generate correlation coefficients for each IAQ variable (i.e., CO₂, PM_{2.5}, moisture) and asthma prevalence to determine whether IAQ variable(s) may be associated with asthma prevalence in schools



V. Linkage Results



Asthma Prevalence in Massachusetts Schools with CO2 Problems¹ 2003/2004 - 2005/2006 School Years

Prevalence ²							
	Low 0% - 8%		Moderate 8.1% - 12%		High 12.1% - 22%		Total
CO2 Assessment	#	%	#	%	#	%	
Non-Problematic ¹ Schools	24	61.5	23	53.5	16	76.2	63
Problematic Schools	15	38.5	20	46.5	5	23.8	40
Total ³	39	100.0	43	100.0	21	100.0	103

Chi square 3.1
p value = 0.22

¹ Schools with CO2 problems are those where greater than 50% of classrooms and libraries have CO2 levels greater than 800 ppm.

² Prevalence of asthma in a school represents the prevalence during the school year during which the IAQ was assessed.

³ Excludes 5 schools that did not report prevalence data.

Asthma Prevalence in Massachusetts Schools with Moisture/Mold Problems¹ 2003/2004 - 2005/2006 School Years

Prevalence ²							
	Low 0% - 8%		Moderate 8.1% - 12%		High 12.1% - 22%		Total
	#	%	#	%	#	%	
Schools with moisture/mold problems ¹	20	51.3	32	74.4	19	90.5	71
Schools without moisture/mold problems	19	48.7	11	25.6	2	9.5	32
Total ³	39	100.0	43	100.0	21	100.0	103

Chi square 10.8
p value < 0.01

¹ Schools with moisture/mold problems are those where at least one classroom or library had water damaged ceiling tiles or carpet or visible mold growth on ceiling or carpet.

² Prevalence of asthma in a school represents the prevalence during the school year during which the IAQ was assessed.

³ Excludes 5 schools that did not report prevalence data.

Asthma Prevalence in Massachusetts Schools & Indoor Air Particulate Levels¹ 2003/2004 - 2005/2006 School Years

Prevalence ²							
	Low 0% - 8%		Moderate 8.1% - 12%		High 12.1% - 22%		Total
	#	%	#	%	#	%	
Schools with mean particulate level \geq 35 ¹	3	7.7	9	20.9	3	14.3	15
Schools with mean particulate level \leq 35	36	92.3	34	79.1	18	85.7	88
Total ³	39	100.0	43	100.0	21	100.0	103

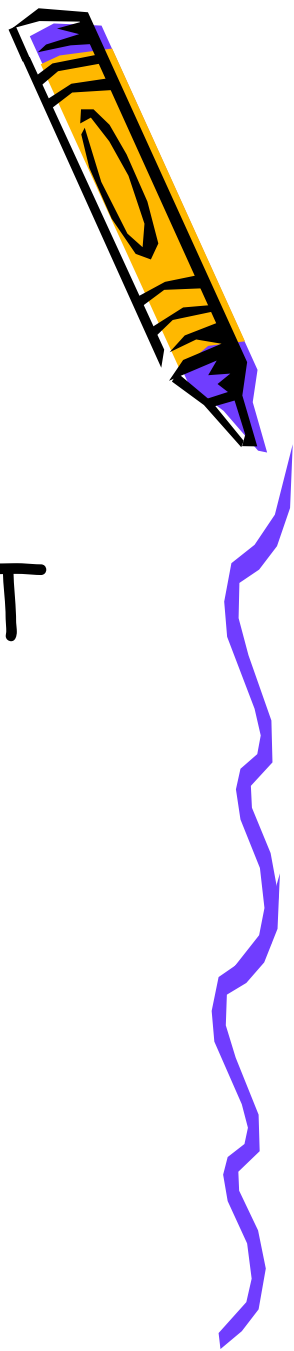
Chi square 2.9
p value < 0.24

¹ A cutoff value of 35 was chosen because it is the new proposed EPA ambient air standard.

² Prevalence of asthma in a school represents the prevalence during the school year during which the IAQ was assessed.

³ Excludes 5 schools that did not report prevalence data.

VI. Summary of the EPHT Experience

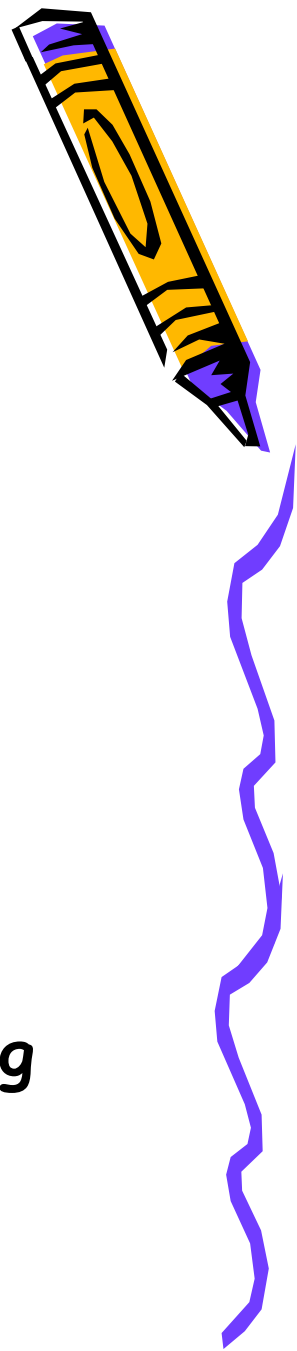


Strengths of Data

- School health record/nurse a reliable source of asthma status information
- First time community-level data available allowing for better characterization of populations with higher rates
- Community-level information facilitates community-specific investigations and interventions



Strengths of Data



- Potential in-school exposures are systematically identified through IAQ assessments
- Opportunities for indoor environmental exposure are identified allowing for linkage with health data
- This tracking effort will allow for generating hypotheses for epidemiologic follow-up



Lessons Learned

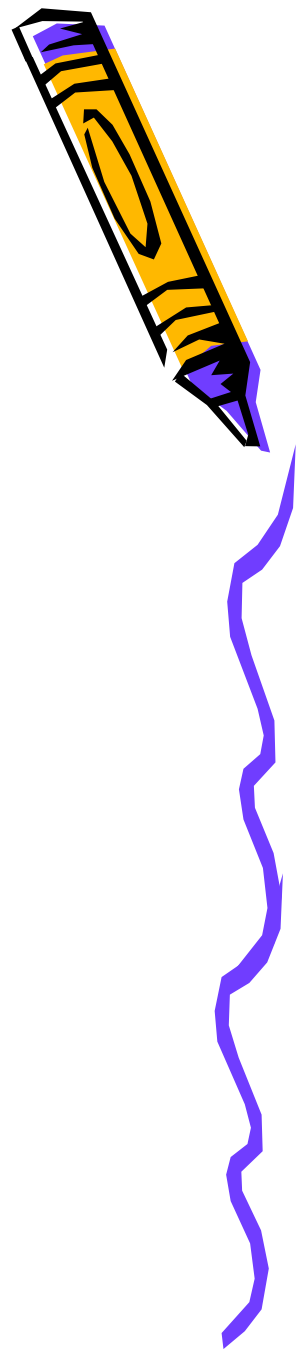


- Linking school wide prevalence data with environmental data can be problematic in isolated areas and may mask any relationship to health effects.



Other Concerns

- Urban vs rural school
- Proximity to traffic/highway
- Home environment
- Health care utilization



Year 1, Year 2 and Year 3 Pediatric Asthma Reports

<http://www.mass.gov/dph/asthma>



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Asthma and Your Environment

- [Asthma and Your Environment Brochures](#)
Some chemicals and pollutants in your environment can make your asthma worse. Your environment is where you live, learn, work, play or visit.
- [Pediatric Asthma Surveillance in Massachusetts \(2004-2005\)](#)
- [Pediatric Asthma Surveillance in Massachusetts \(2003-2004\)](#)
- [Pediatric Asthma Surveillance in Massachusetts \(2002-2003\)](#)

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IAQ Materials and Information http://mass.gov/dph/indoor_air



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Indoor Air Quality

These indoor air quality assessments are conducted in public schools, courthouses, town halls, libraries and other public buildings or buildings that the public may enter.

Health & Human Services

- [Overview of Indoor Air Quality in Buildings](#)
- [Indoor Air Quality Reports \(Listed by Community\)](#)
- [General Appendices for IAQ Reports](#)
- [Environmental Health & Safety Issues in Mass Schools - School Checklist](#)
Information regarding environmental and safety issues in Massachusetts schools.
- [Chemical Storage](#)
A list of examples of improper storage of chemicals in schools' science laboratory which could create indoor environmental pollutants as well as potential safety hazards.
- [Ice Rinks](#)
Requirements to maintain air quality in indoor skating rinks to ensure the public health and safety of patrons who use indoor skating rinks.
- [Mold, Moisture, and Mildew](#)
Information on ways to prevent mold growth in schools and decrease relative humidity, dew point, etc.
- [Renovations](#)
Information regarding duct cleanliness for new constructions, as well as additional related information provided by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
- [Ventilation](#)
Information on ways to investigate odor complaints in nail salons, as well as information on fresh air supplies and exhaust vents in schools.

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Indoor Air Quality Reports

http://mass.gov/dph/indoor_air



Towns Listed from A to D

To obtain copies of any IAQ assessment prior to 2000, contact the [Center for Environmental Health](#).

Indoor Air Quality Reports by Community	Formats	
Acushnet		
Acushnet Elementary School (2002)	PDF	Word
Agawam		
James Clark Elementary School (2003)	PDF	Word
Amesbury		
Amesbury Fire Department (2002)	PDF	Word
Amesbury Middle School (1998)	Not available online.	
Amesbury Town Hall Reassessment (2003)	PDF	Word
Amesbury Town Hall (2001)	PDF	RTF
Community Action Head Start, Friends Meeting House (2002)	PDF	Word
Amherst		
Jones Library	PDF	RTF
Wildwood Elementary School (2004)	PDF	Word
Andover		
Bancroft Elementary School	Not available online.	
Arlington		
M.Norcross Stratton Elementary School (2005)	PDF	Word
Ashburnham		
John R. Briggs Elementary School Reassessment (2005)	PDF	Word
John R. Briggs Elementary School Reassessment (2003)	PDF	Word
John R. Briggs Elementary School	PDF	RTF
Athol		
Riverbend Elementary School (2003)	PDF	Word
Attleboro		
Grace Baptist Christian Academy (2004)	PDF	Word
Auburn		
Auburn High School	PDF	RTF

